

## GENERAL DESCRIPTION

The PJ30072 is a synchronous step-up DC/DC converter. That is based on constant Off Time/PSM controller topology. The IC enters PSM mode automatically at light load, the goal is to improve efficiency and reduce quiescent current.

The PJ30072 provide a complete power supply solution for products powered by one or two Alkaline, Ni-Cd, or Ni-MH battery cells. It stays in operation with supply voltages down to 0.7 V. The implemented boost converter is based on a constant Off Time/PSM controller topology using an internal synchronous rectifier to obtain maximum efficiency.

A low-EMI mode is implemented to reduce ringing and in effect lower radiated electromagnetic energy when the converter enters the discontinuous conduction mode.

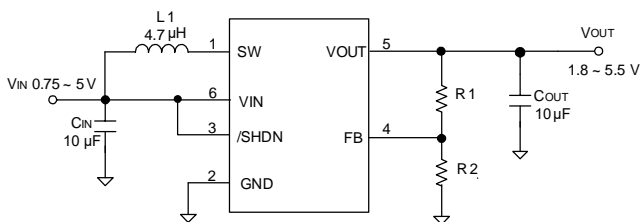
## FEATURES

- ◆ Deliver 3.3 V at 60 mA from a single Alkaline/ Ni-MH or 3.3 V at 120 mA from two cells
- ◆ Up to 94% efficiency
- ◆ Low shutdown current : < 1  $\mu$ A
- ◆ Low quiescent current : 12  $\mu$ A
- ◆ Low no-load input current
- ◆ Output disconnect by shutdown function
- ◆ Package: SOT23-6

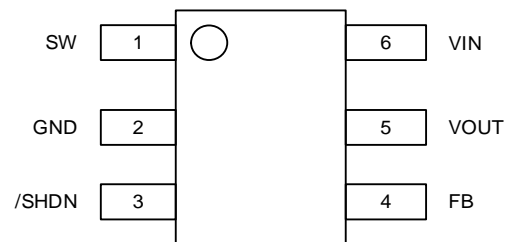
## APPLICATIONS

- ◆ Wireless mice
- ◆ Medical instruments
- ◆ Smart phones
- ◆ Bluetooth devices

## SIMPLIFIED SCHEMATIC



## PIN CONFIGURATION



**SOT23-6 (Top View)**

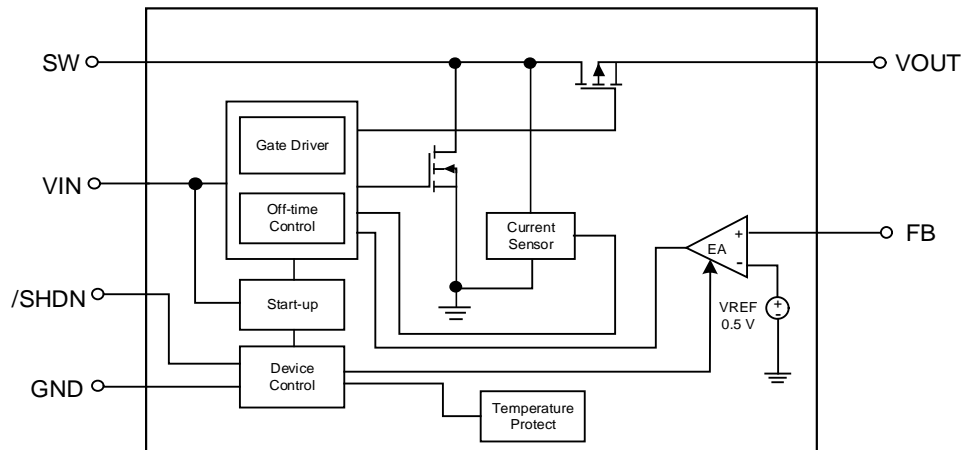
## ORDERING INFORMATION

| ORDER NUMBER | Marking ID | Package | Description                                       |
|--------------|------------|---------|---|
| PJ30072S6_R1 | A5 DNN     | SOT23-6 | Halogen free RoHS compliant in T/R, 3000 pcs/Reel |

## MARKING INFORMATION

| Marking | Package | Definition                                 |
|---------|---------|--|
| A5 DNN  | SOT23-6 | A5: Product code D: Day code NN: Serial No |

## Functional Block Diagram



## FUNCTIONAL PIN DESCRIPTION

| TERMINAL |       | I/O <sup>(1)</sup> | DESCRIPTION  |
|----------|-------|--------------------|--|
| NUMBER   | NAME  |                    |  |
| 1        | SW    | P                  | Switch pin. Connect Inductor between VIN and this pin.                                       |
| 2        | GND   | G                  | Power ground   |
| 3        | /SHDN | I                  | Logic controlled shutdown input.<br>/SHDN = High: normal operation; /SHDN = Low: IC shutdown |
| 4        | FB    | I                  | Feedback input to error amplifier. Connect resistor divider tap to this pin.                 |
| 5        | VOUT  | P                  | Output voltage sense and drain of the internal synchronous rectifier.                        |
| 6        | VIN   | P                  | Input supply pin.  |

(1) I – Input; O – Output; P – Power; G – Ground

## ABSOLUTE MAXIMUM RATINGS

Stresses beyond those listed under the Absolute Maximum Rating table may cause permanent damage to the device. These are stress ratings only and functional operation of the device at these or any other condition beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability. Panjit does not recommend exceeding them or designing to absolute maximum ratings.

| Symbol                     | Parameter                                    | Rating     | Unit |
|----------------------------|--|------------|------|
| Voltage range at terminals | FB, /SHDN, OUT, VIN voltage                  | -0.3 to 6  | V    |
|                            | SW voltage: DC                               | -0.3 to 6  | V    |
|                            | SW voltage: pulsed < 100 ns                  | -0.3 to 7  | V    |
| T <sub>A</sub>             | Operating ambient temperature range          | -40 to 85  | °C   |
| T <sub>J</sub>             | Maximum operating junction temperature range | 150        | °C   |
| T <sub>STG</sub>           | Storage temperature range                    | -65 to 150 | °C   |
| T <sub>L</sub>             | Lead temperature range                       | 260        | °C   |
| R <sub>θJA</sub>           | Thermal resistance junction to ambient       | 250        | °C/W |
| ESD                        | HBM: JS001-JEDEC                             | ±2         | kV   |

## RECOMMENDED OPERATING CONDITIONS

The Recommended Operating Conditions table defines the conditions for actual device operation. Recommended operating conditions are specified to ensure optimal performance to the datasheet specifications.

| Symbol          | Parameter                   | Rating                   | Unit |
|-----------------|-----------------------------|--------------------------|------|
| V <sub>IN</sub> | Input voltage               | 0.75 to V <sub>OUT</sub> | V    |
| T <sub>A</sub>  | Operating temperature range | -40 to 85                | °C   |

## ELECTRICAL CHARACTERISTICS

$V_{IN} = 1.2\text{ V}$ ,  $V_{OUT} = 3.3\text{ V}$ ,  $T_A = 25^\circ\text{C}$ , unless otherwise specified.

| Symbol           | Parameter                             | Test Conditions  | Min | Typ  | Max | Unit             |
|------------------|---------------------------------------|--|-----|------|-----|------------------|
| $V_{OUT}$        | Output voltage range                  |  | 1.8 |      | 5.5 | V                |
| $V_{ST}$         | Minimum start-up voltage              | $R_L = 3.3\text{ k}\Omega$   |     | 0.75 | 0.9 | V                |
| $V_{IN}$         | Input operation voltage               |  | 0.7 |      | 5.5 | V                |
| $V_{UVLO}$       | UVLO of $V_{IN}$                      | $V_{IN}$ decreasing  |     | 0.5  | 0.7 | V                |
| $I_Q$            | Quiescent current (PSM)               | $V_{IN} = 1.2\text{ V}$ , $V_{OUT} = 3.3\text{ V}$ ,<br>$V_{FB} = 0.55\text{ V}$ |     | 12   | 25  | $\mu\text{A}$    |
| $I_{SD}$         | IC shutdown current                   | $/\text{SHDN} = 0\text{ V}$ , $V_{OUT} = 1.1\text{ V}$                           |     | 0.01 | 1   | $\mu\text{A}$    |
| $F_{SW}$         | Oscillator frequency                  |  |     | 1.0  |     | MHz              |
| $V_{FB}$         | Feedback voltage                      |  | 490 | 500  | 510 | mV               |
| $I_{FB}$         | FB input leakage current              | $V_{FB} = 1.3\text{ V}$  |     | 1    | 50  | nA               |
| $I_{LH}$         | Inductor current ripple               |  |     | 200  |     | mA               |
| $T_{OFF}$        | Constant off time                     | $V_{IN} = 1.2\text{ V}$ , $V_{OUT} = 3.3\text{ V}$                               |     | 400  |     | nS               |
|                  | Line regulation <sup>(1)</sup>        | $V_{IN} < V_{OUT}$   |     | 0.5% |     |                  |
|                  | Load regulation <sup>(1)</sup>        | $V_{IN} < V_{OUT}$   |     | 0.5% |     |                  |
| $I_{SW\_LKG\_N}$ | NMOS switch leakage                   | $V_{SW} = 5\text{ V}$  |     | 0.1  | 5   | $\mu\text{A}$    |
| $I_{SW\_LKG\_P}$ | PMOS switch leakage                   | $V_{SW} = 5\text{ V}$ , $V_{OUT} = 0\text{ V}$                                   |     | 0.1  | 10  | $\mu\text{A}$    |
| $R_{DS(on)_N}$   | NMOS switch on resistance             | $V_{IN} = 1.2\text{ V}$ , $V_{OUT} = 3.3\text{ V}$                               |     | 250  |     | m $\Omega$       |
| $R_{DS(on)_P}$   | PMOS switch on resistance             | $V_{IN} = 1.2\text{ V}$ , $V_{OUT} = 3.3\text{ V}$                               |     | 350  |     | m $\Omega$       |
| $V_{IH}$         | $/\text{SHDN}$ High threshold voltage | $V_{IN} = 1.2\text{ V}$  | 0.8 |      |     | V                |
| $V_{IL}$         | $/\text{SHDN}$ Low threshold voltage  | $V_{IN} = 1.2\text{ V}$  |     |      | 0.2 | V                |
| $I_{SHDN}$       | $/\text{SHDN}$ pin input current      | $/\text{SHDN} = 5.5\text{ V}$  |     | 0.01 | 1.0 | $\mu\text{A}$    |
| $I_{LIM}$        | NMOS current limit                    | $V_{IN} = 1.2\text{ V}$ , $V_{OUT} = 3.3\text{ V}$                               |     | 0.75 |     | A                |
| $T_{OTP}$        | Over temperature protection           |  |     | 150  |     | $^\circ\text{C}$ |
| $T_{HYST}$       | Over temperature hysteresis           |  |     | 30   |     | $^\circ\text{C}$ |

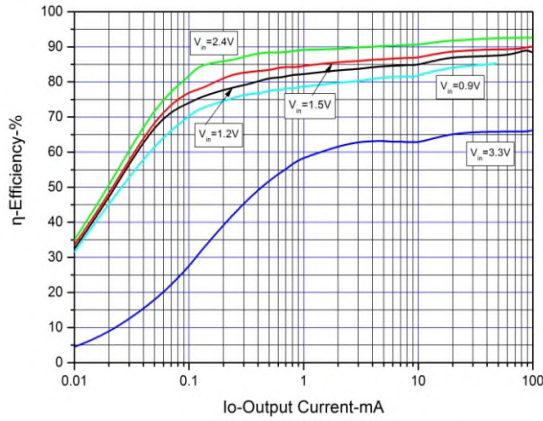
**Note:**

(1) Guaranteed by design.

(2) Specifications subject to change without notice.

## TYPICAL PERFORMANCE CHARACTERISTIC

$V_{IN} = 1.2\text{ V}$ ,  $V_{OUT} = 3.3\text{ V}$ ,  $L = 4.7\text{ }\mu\text{H}$ ,  $C_{IN} = C_{OUT} = 10\text{ }\mu\text{F}$ ,  $T_A = 25^\circ\text{C}$ , unless otherwise specified.



$V_{OUT} = 3\text{ V}$

Figure-1. Efficiency vs. Output current and input voltage

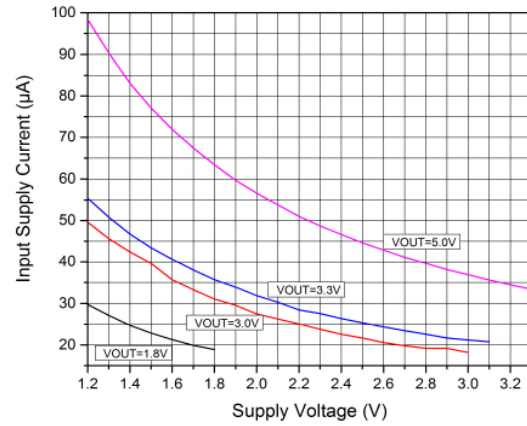
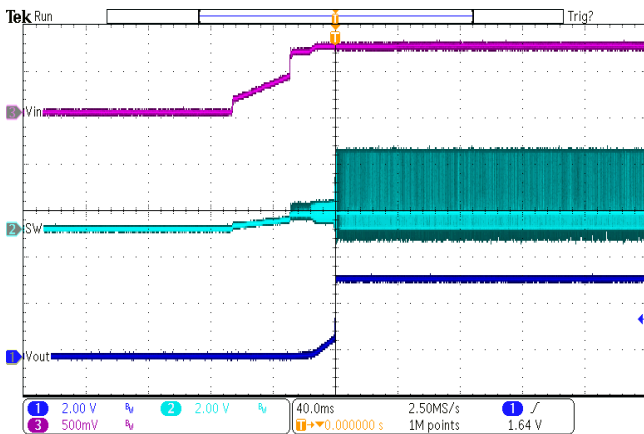
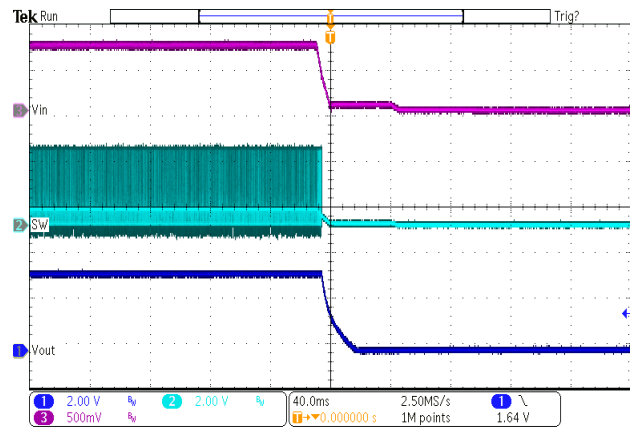


Figure-2. No load input current vs. Input voltage device enabled



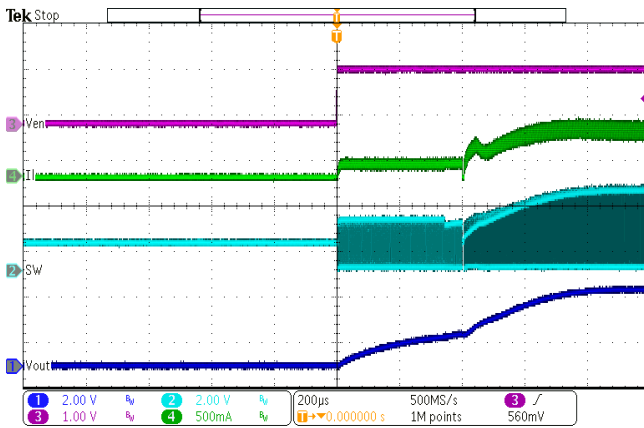
$V_{IN} = 0.7\text{ V}$ ,  $V_{OUT} = 3.3\text{ V}$ ,  $R_{load} = 1\text{ k}\Omega$

Figure-3. VIN start



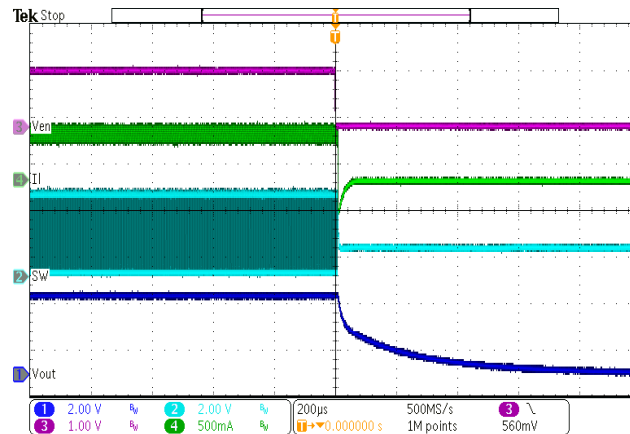
$V_{IN} = 0.7\text{ V}$ ,  $V_{OUT} = 3.3\text{ V}$ ,  $R_{load} = 1\text{ k}\Omega$

Figure-4. VIN drop



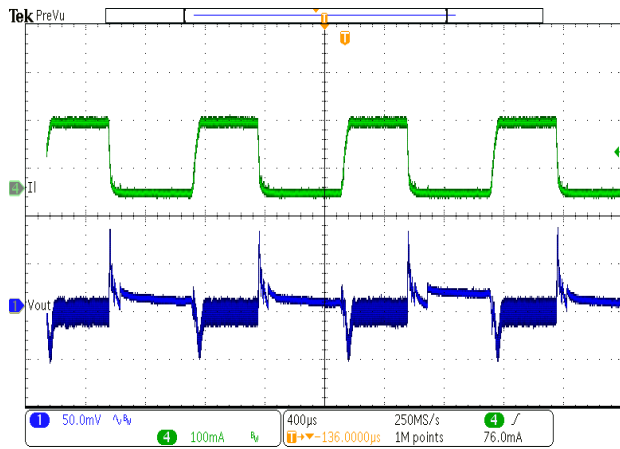
$V_{IN} = 1.2\text{ V}$ ,  $V_{OUT} = 3.3\text{ V}$ ,  $R_{load} = 22\text{ }\Omega$

Figure-5. VEN start up



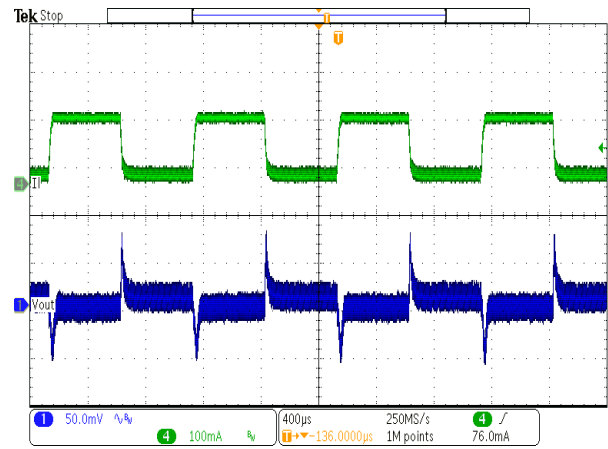
$V_{IN} = 1.2\text{ V}$ ,  $V_{OUT} = 3.3\text{ V}$ ,  $R_{load} = 22\text{ }\Omega$

Figure-6. VEN drop



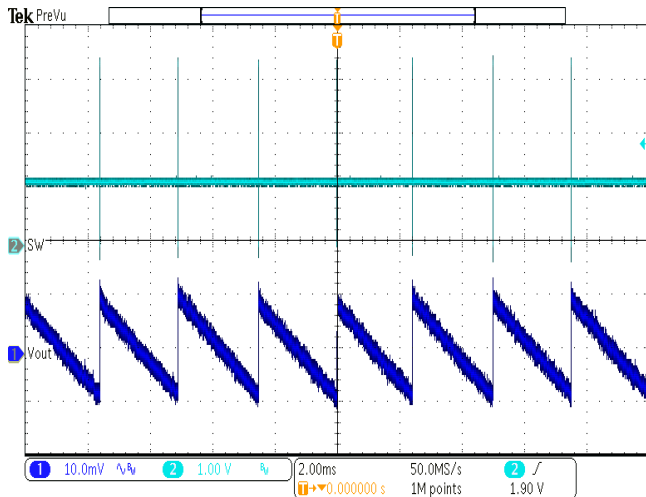
$V_{IN} = 1.2\text{ V}$ ,  $V_{OUT} = 3.3\text{ V}$ ,  $0\text{ A} \sim 150\text{ mA}$

**Figure-7. Load transient**



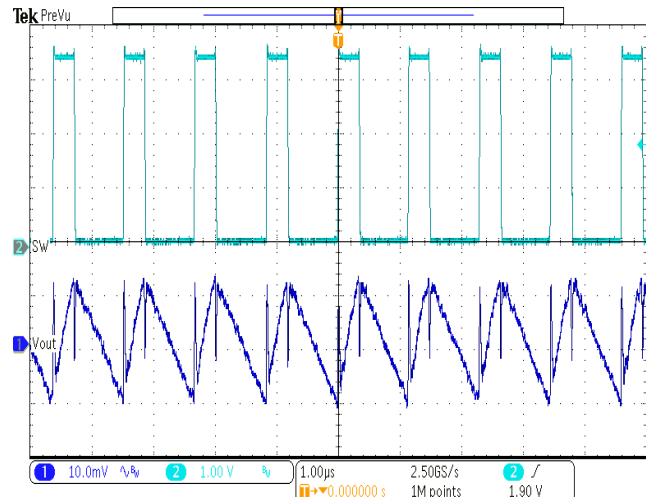
$V_{IN} = 1.2\text{ V}$ ,  $V_{OUT} = 3.3\text{ V}$ ,  $30\text{ mA} \sim 150\text{ mA}$

**Figure-8. Load transient**



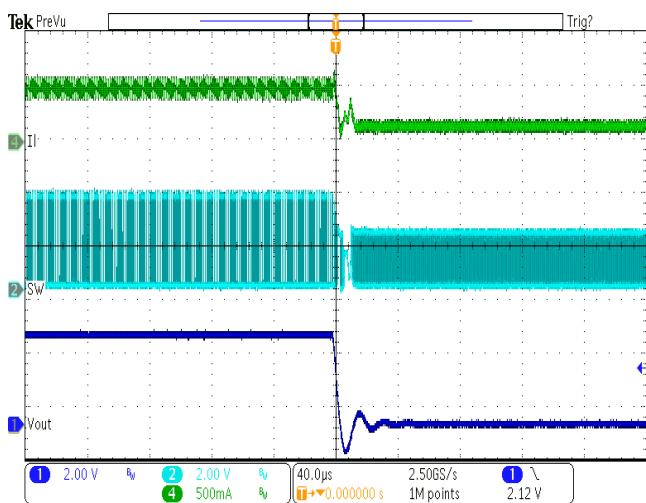
$V_{IN} = 1.2\text{ V}$ ,  $V_{OUT} = 3.3\text{ V}$ ,  $I_{load} = 0\text{ A}$

**Figure-9. Ripple**



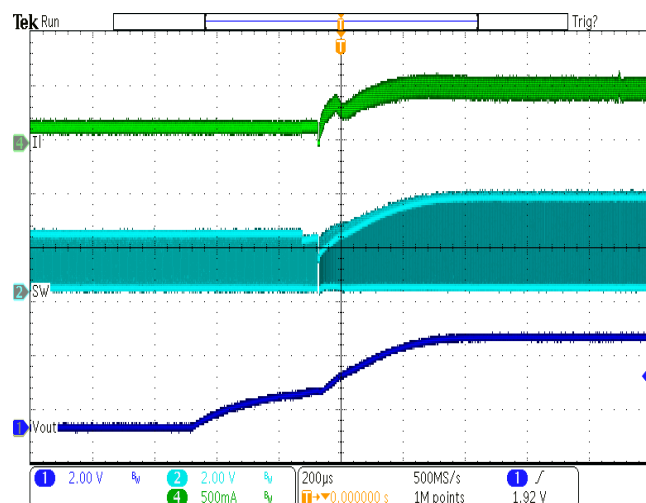
$V_{IN} = 1.2\text{ V}$ ,  $V_{OUT} = 3.3\text{ V}$ ,  $I_{load} = 150\text{ mA}$

**Figure-10. Ripple**



$V_{IN} = 1.2\text{ V}$ ,  $V_{OUT} = 3.3\text{ V}$ , Load =  $22\ \Omega$  -> short

**Figure-11. Short circuit protection**



$V_{IN} = 1.2\text{ V}$ ,  $V_{OUT} = 3.3\text{ V}$ , short -> Load =  $22\ \Omega$

**Figure-12. Short circuit recovery**

## APPLICATIONS INFORMATION

The PJ30072 is a synchronous step-up DC-DC converter. It is based on constant Off Time/PSM controller topology. At the beginning of each clock cycle, the main switch (NMOS) is turned on and the inductor current starts to ramp. After the sense current signal equals the error amplifier (EA) output, the main switch is turned off and the synchronous switch (PMOS) is turned on. The device can operate with an input voltage below 1V; the typical start-up voltage is 0.75 V.

### Current limit

The over current protection is to limit the switch current. The output voltage will be dropped when over current is happened. The current limit amplifier will turn off switch once the current exceeds its threshold.

### Zero current comparator

The zero current comparator monitors the inductor current to the output and shuts off the synchronous rectifier, this prevents the inductor current from reversing in polarity improving efficiency at light loads.

### Device shutdown

When /SHDN is set logic high, the PJ30072 is put into active mode operation. If /SHDN is set logic low, the device is put into shutdown mode and consumes less than 1μA of current. At the shutdown mode, the synchronous switch will turn off and the output voltage of PJ30072 step-up converter will reduce to 0V. After start-up, the internal circuitry is supplied by  $V_{OUT}$ , however, if shutdown mode is enabled, the internal circuitry will be supplied by the input source again.

### Adjustable output voltage

An external resistor divider is used to set the output voltage. The output voltage of the switching regulator ( $V_{OUT}$ ) is determined by the following equation:

$$V_{OUT} = V_{FB} \times \left( 1 + \frac{R_1}{R_2} \right) \quad (1)$$

Where  $V_{FB}$  is 0.5 V reference voltage.

### Input inductor selection

A 2.2μH ~ 6.8μH input inductor is commanded for most PJ30072 applications. The 4.7μH input inductor can get the good performance over the whole converter ratio cases. The inductor which is smaller than 2.2μH is not recommended to use. It is important to ensure the inductor saturation current exceeding the peak inductor current in application to prevent core saturation.

### **Input capacitor selection**

Surfaces mount 4.7 $\mu$ F or greater, X5R or X7R, ceramic capacitor is suggested for the input capacitor. The input capacitor provides a low impedance loop for the edges of pulsed current drawn by the PJ30072. Low ESR/ESL X7R and X5R ceramic capacitors are ideal for this function. To minimize stray inductance, the capacitor should be placed as close as possible to the IC. This keeps the high frequency content of the input current localized, minimizing EMI and input voltage ripple. Always examine the ceramic capacitor DC voltage coefficient characteristics to get the proper value.

### **Output capacitor selection**

The output capacitor limits the output ripple and provides holdup during large load transitions. A 4.7 $\mu$ F to 10 $\mu$ F, X5R or X7R, ceramic capacitor is suggested for the output capacitor. Typically the recommended capacitor range provides sufficient bulk capacitance to stabilize the output voltage during large load transitions and has the low ESR and ESL characteristics necessary for low output voltage ripple.

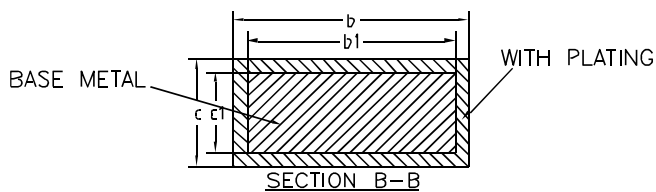
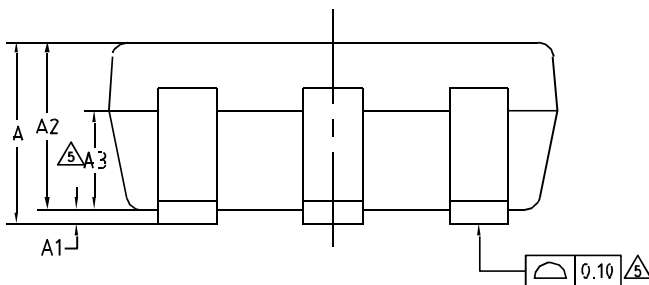
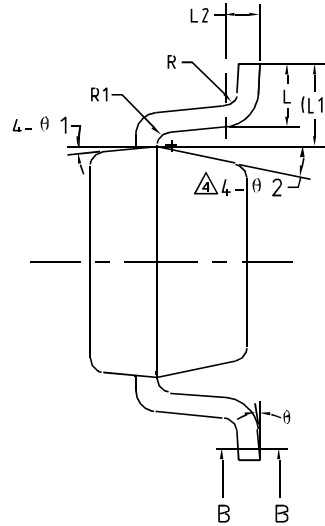
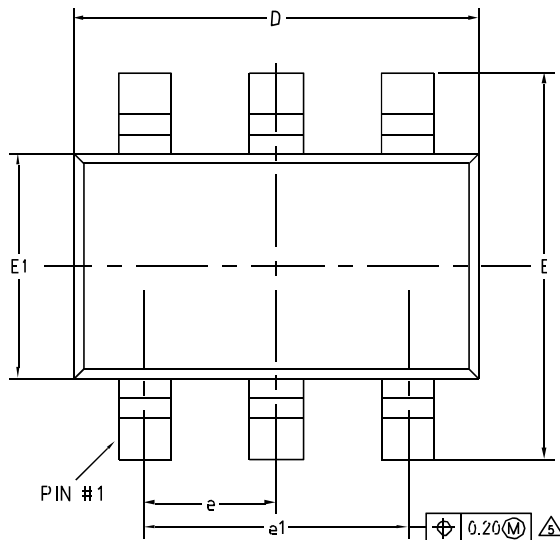
### **PCB layout guidance**

This is a considerably high frequency for DC-DC converters. PCB layout is important to guarantee satisfactory performance. It is recommended to make traces of the power loop, especially where the switching node is involved, as short and wide as possible. First of all, the inductor, input and output capacitor should be as close as possible to the device. Feedback and shutdown circuits should avoid the proximity of large AC signals involving the power inductor and switching node.



## PACKAGE DIMENSION – SOT23-6

SOT23-6 Unit (mm)



| Common Dimensions<br>(Units of measure = Millimeter) |          |       |       |
|--|----------|-------|-------|
| Symbol   | Min      | Nom   | Max   |
| A  | -        | -     | 1.25  |
| A1   | 0        | -     | 0.15  |
| A2   | 1.00     | 1.10  | 1.20  |
| A3   | 0.60     | 0.65  | 0.70  |
| b  | 0.36     | -     | 0.50  |
| b1   | 0.36     | 0.38  | 0.45  |
| c  | 0.14     | -     | 0.20  |
| c1   | 0.14     | 0.15  | 0.16  |
| D  | 2.826    | 2.926 | 3.026 |
| E  | 2.60     | 2.80  | 3.00  |
| E1   | 1.526    | 1.626 | 1.726 |
| e  | 0.90     | 0.95  | 1.00  |
| e1   | 1.80     | 1.90  | 2.00  |
| L  | 0.35     | 0.45  | 0.60  |
| L1   | 0.59 REF |       |       |
| L2   | 0.25 BSC |       |       |
| R  | 0.10     | -     | -     |
| R1   | 0.10     | -     | 0.25  |
| θ  | 0°       | -     | 8°    |
| θ1   | 3°       | 5°    | 7°    |
| θ2   | 6°       | -     | 14°   |

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